

A phase-space coupled hybrid framework for combined continuum/rarefied high speed flows

Completed Technology Project (2015 - 2022)



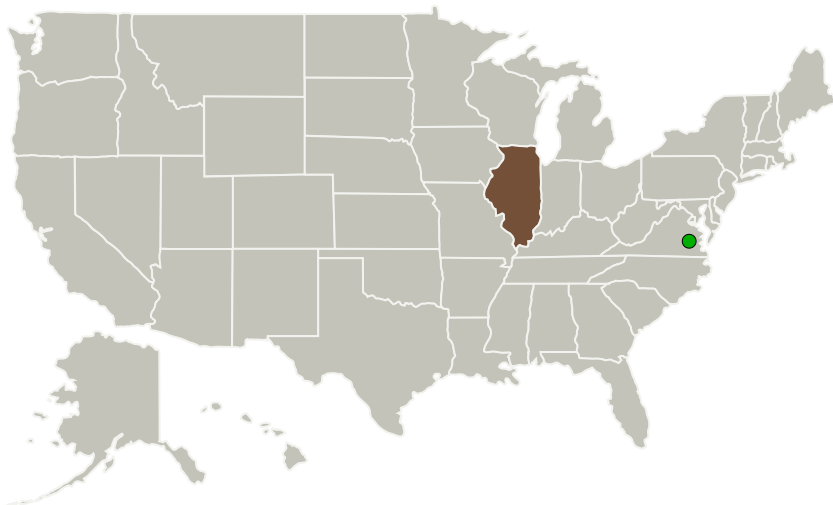
Project Introduction

This Early Career Faculty Award will support the development of a novel phase-space coupled hybrid framework for mixed continuum/rarefied flows. Flow structures that develop around high-speed atmospheric entry vehicles often contain localized flow regions where rarefied (or non-continuum) effects, within an otherwise continuum description, lead to significant modeling uncertainty. Hybrid techniques that incorporate both continuum and kinetic computational methodologies offer an elegant balance of computational efficiency and accuracy for simulations involving mixed continuum/rarefied flow regimes. These efforts will construct a foundational hybrid framework for chemically reacting flows from Generalized Chapman-Enskog (GCE) Theory. Broad research opportunities exist in the development of this hybrid methodology, and a number of novel contributions are anticipated from these efforts including: (i) consistent state-based kinetics models for CFD/DSMC flow solvers, (ii) new set of GCE continuum breakdown parameters and assessment of continuum breakdown for reacting flows, (iii) a novel phase-space coupling procedure for improved statistics in DSMC tail-driven processes.

Anticipated Benefits

Hybrid techniques that incorporate both continuum and kinetic computational methodologies offer an elegant balance of computational efficiency and accuracy for simulations involving mixed continuum/rarefied flow regimes.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
University of Illinois at Urbana-Champaign	Lead Organization	Academia	Urbana, Illinois
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

Illinois

Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Illinois at Urbana-Champaign

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

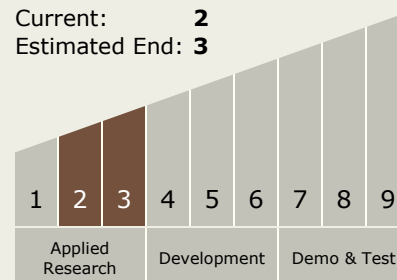
Hung D Nguyen

Principal Investigator:

Kelly Stephani

Technology Maturity (TRL)

Start: 2
Current: 2
Estimated End: 3



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Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.5 Hybrids

Target Destination

Outside the Solar System